

Underbalanced Drilling

Saves \$1.4 Million in Mud Costs in Unstable Exploratory Gas Well



Weatherford performed UBD using a booster compressor (above) to mitigate mud losses and drill the section to TD. This type of compressor takes a high volume of gas at a low pressure—between 175 to 350 psi (1.2 to 2.4 MPa)—from the primary compressor and boosts it to a high pressure.

Objectives

- Overcome partial and total mud losses and the associated nonproductive time (NPT) while drilling a 3,248-ft (990-m) section in an exploratory well with unstable hole conditions. The operator had experienced several partial mud-loss events when using conventional techniques to drill the well.
- Maintain circulation to reduce mud losses and the possibility of stuck pipe during drilling.

Our Approach

- The Weatherford crew implemented underbalanced drilling (UBD) techniques using an aerated mud system to minimize the equivalent circulating density (ECD) at the bottom of the hole and, in turn, overcome total and partial mud losses. High ECDs had a tendency to fracture the formation because of its very low fracture gradient.
- The crew began drilling the 20-in. section at a depth of 509 ft (155 m) and experienced lack of circulation and total mud losses at 1,076 ft (328 m).

LOCATION

Peru

WELL TYPE

Onshore, gas, exploration

FORMATION

Upper Yuahuarango

LITHOLOGY

Claystone and sandstone layers

BIT SIZE

20 in.

TOTAL DEPTH

3,757 ft (1,145 m)

PRODUCTS/SERVICES

- Secure Drilling services
- Underbalanced drilling



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Our Approach (continued)

- The crew began using aerated mud to circulate the well. Initially, this two-phase fluid consisted of 9.0-lb/gal (1,078 kg/m³) drilling fluid flowing at 800 gal/min (3,028 L/min) and air flowing at 1,000 scf/min (28 m³/min), which resulted in an ECD of 7.78 lb/gal (932 kg/m³) at bottom.
- As the operator drilled deeper, the crew analyzed information at the surface and changed the mixture of air and mud accordingly. At the bottom of the section, the two-phase fluid consisted of the same density drilling fluid flowing at 800 gal/min (3,028 L/min) and air flowing at 1,800 scf/min (50 m³/min), which resulted in an ECD of 8.04 lb/gal (9.36 kg/m³).
- By closely controlling the ECD, the crew enhanced wellbore stability and increased the rate of penetration compared to conventional methods from 22 ft/hr (6.8 m/hr) to between 49 and 66 ft/hr (15 and 20 m/hr).
- The operation was completed in accordance with safety and security standards.

Value to Client

- The UBD technique maintained circulation, mitigated total mud losses, and reduced NPT during drilling in a well that would have been impossible to drill using conventional techniques.
- Using UBD enabled the operator to reduce mud losses, which could have been as much as 30,000 barrels, and save more than 12,000 barrels of mud valued at US \$1,440,000.

